

(photo in APS 2008 calendar)

# SciBooNE Neutrino Experiment at Fermilab; overview

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Apr 12, APS meeting

# Outline

- What's SciBooNE?
- Introduction
- SciBooNE Experiment
- Timeline & Current Status
- Summary

# SciBooNE Collaboration

- Universitat Autonoma de Barcelona
- University of Cincinnati
- University of Colorado, Boulder
- Columbia University
- Fermi National Accelerator Laboratory
- High Energy Accelerator Research Organization (KEK)
- Imperial College London
- Indiana University
- Institute for Cosmic Ray Research (ICRR)
- Kyoto University
- Los Alamos National Laboratory
- Louisiana State University
- Purdue University Calumet
- Università degli Studi di Roma "La Sapienza" and INFN
- Saint Mary's University of Minnesota
- Tokyo Institute of Technology
- Universidad de Valencia

## Spokespeople:

M.O. Wascko (Imperial), T. Nakaya (Kyoto)

5 countries 17 institutions



# What's SciBooNE?

- Neutrino experiment at Fermilab (E954)
- Precision measurement of  $\nu$  and  $\bar{\nu}$ -nucleus cross section around 1GeV.
  - Important for long base-line oscillation experiments in next generation.

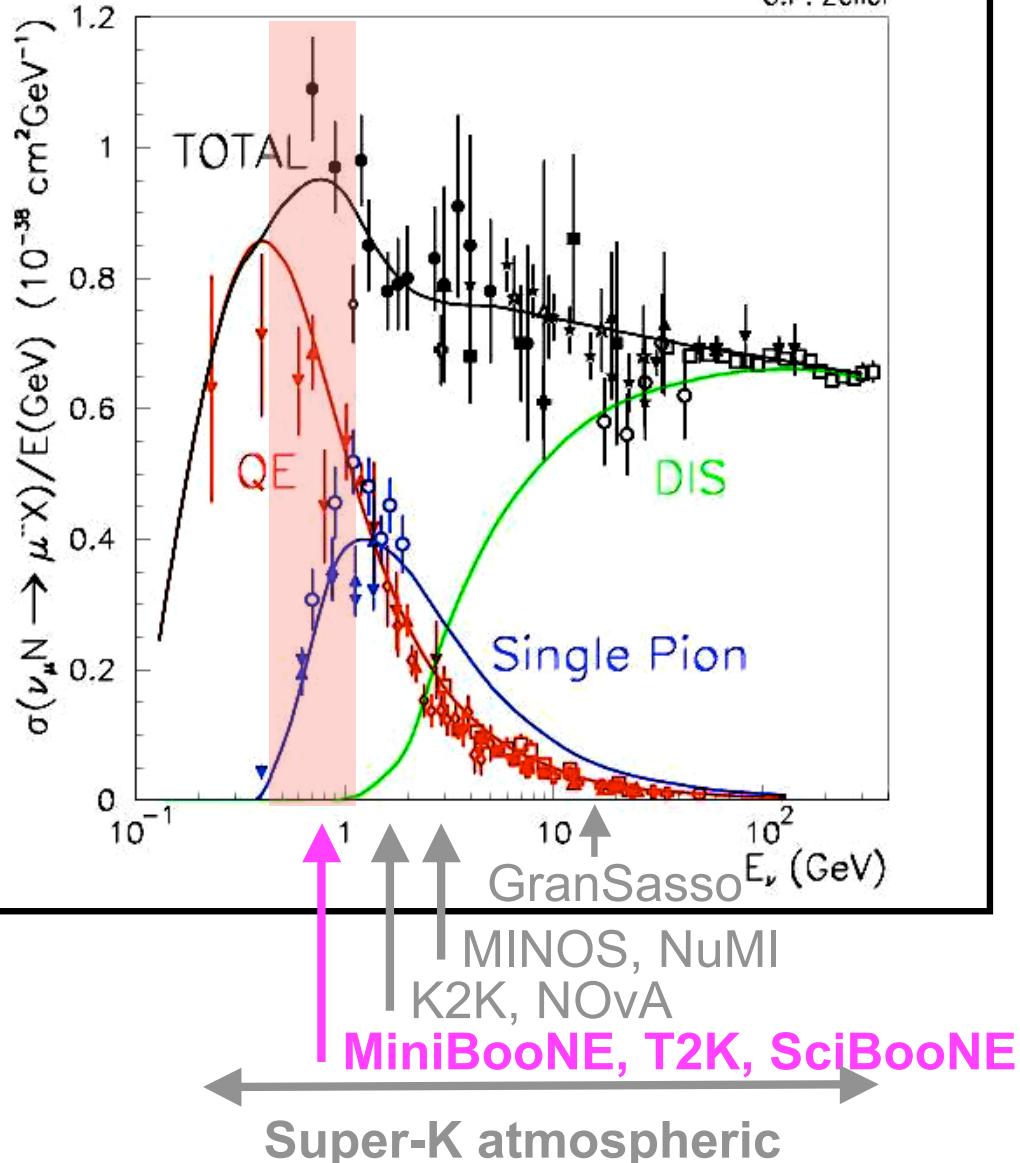


# Unexplored area of Neutrino Physics

## ~neutrino-nucleus cross sections~

### Charged Current cross sections

G.P. Zeller



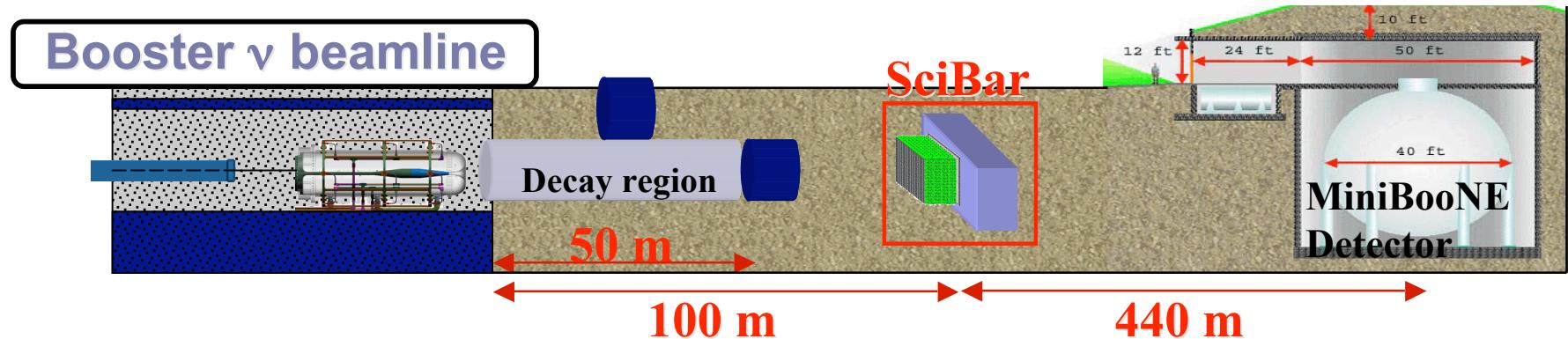
- Existing data: 1970-1980
  - Low statistics
  - Systematic uncertainties
  - High energy region
- Less precise measurements at  $\sim 1\text{GeV}$  region
  - Many processes contribute.
- Scarce antineutrino cross section data
- Oscillation experiments require precise knowledge on  $\bar{\nu}$ -nucleus interactions.

→ Need new measurement

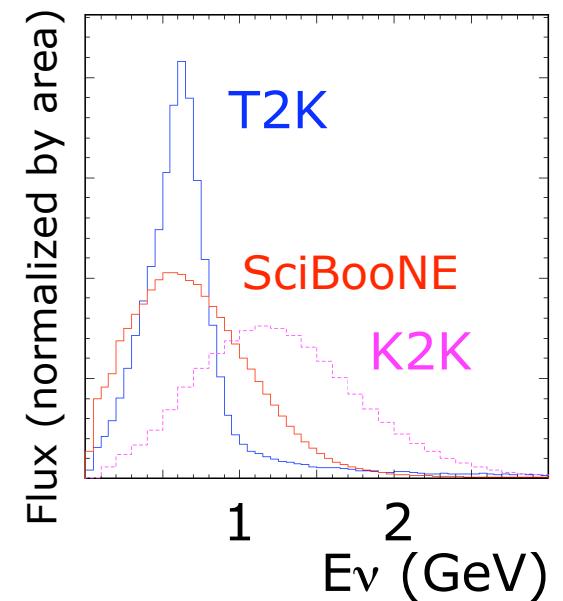
# SciBooNE Experiment

# SciBooNE Experiment

(K2K-SciBar detector at FNAL Booster Neutrino Beam line)



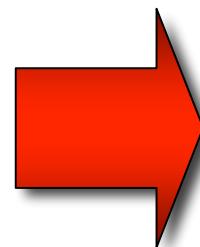
- Precision measurement of  $\nu$  &  $\bar{\nu}$ -bar cross sections at  $\sim 1\text{GeV}$ .
- **SciBar:**
  - Originally K2K-near detector
  - Shipped to FNAL
- **BNB: Intense & low energy  $\nu$  beam**
  - $E\nu$  good match to T2K
  - $\nu$  and  $\bar{\nu}$  beam
- **MiniBooNE near detector**



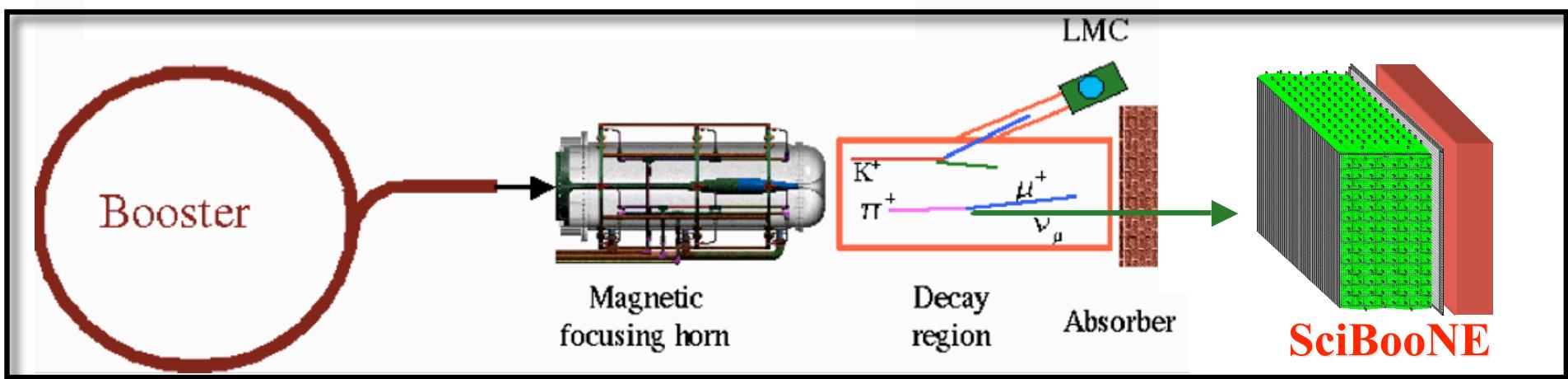
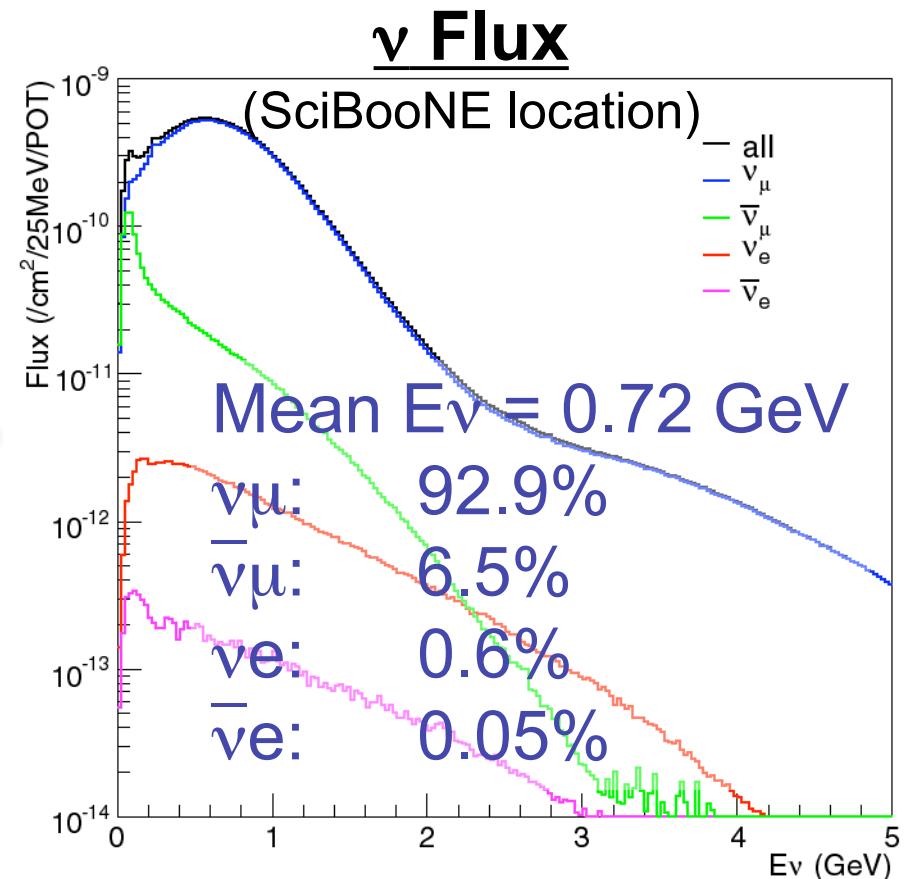
# Neutrino Beam

- 8 GeV protons from **Booster**

- Protons hit beryllium target (71 cm long, 1 cm diameter) within a **magnetic focusing horn** and produce mesons
- The mesons decay into neutrinos in 50m **decay region**

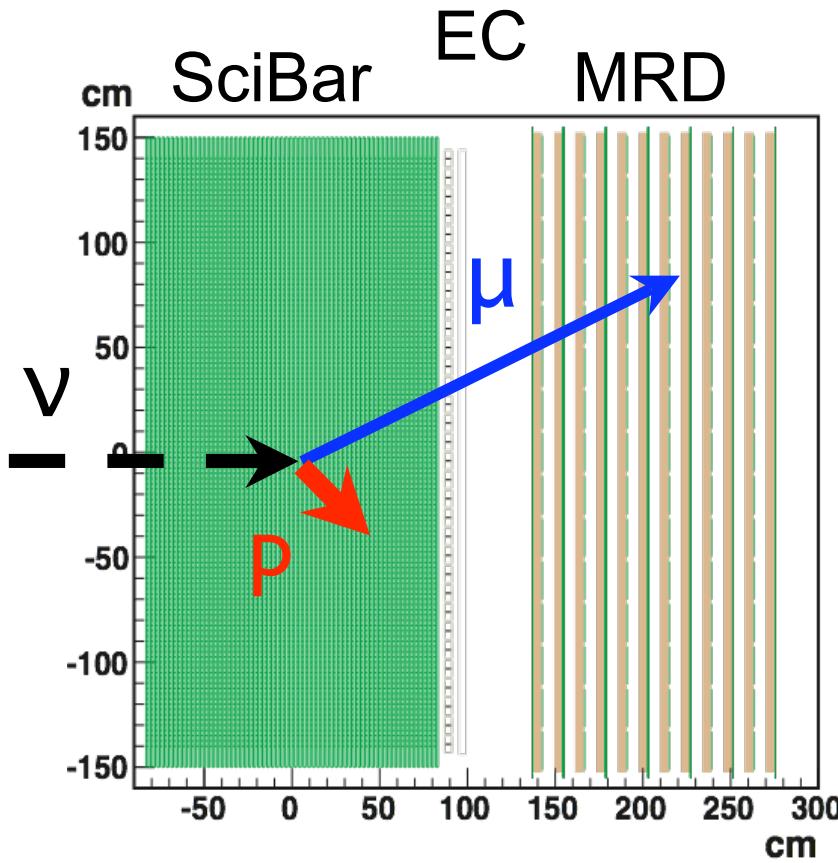


- Neutrinos are observed in **SciBooNE** (100m)
- $\bar{\nu}$  beam by changing horn polarity



# SciBooNE Detectors

# SciBooNE detectors



Schematic  
charged-current  
quasi-elastic (CCQE)  
 $\nu + n \rightarrow \mu + p$   
interaction

**SciBar:** fully active target  
total mass 15t, fiducial  $\sim$ 10t  
14,336 channels  
**extruded scinti.** + 64ch MA-PMT

- Light yield for MIP:  $\sim$ 20 p.e./1.3cm
- Hit finding efficiency: >99.8%

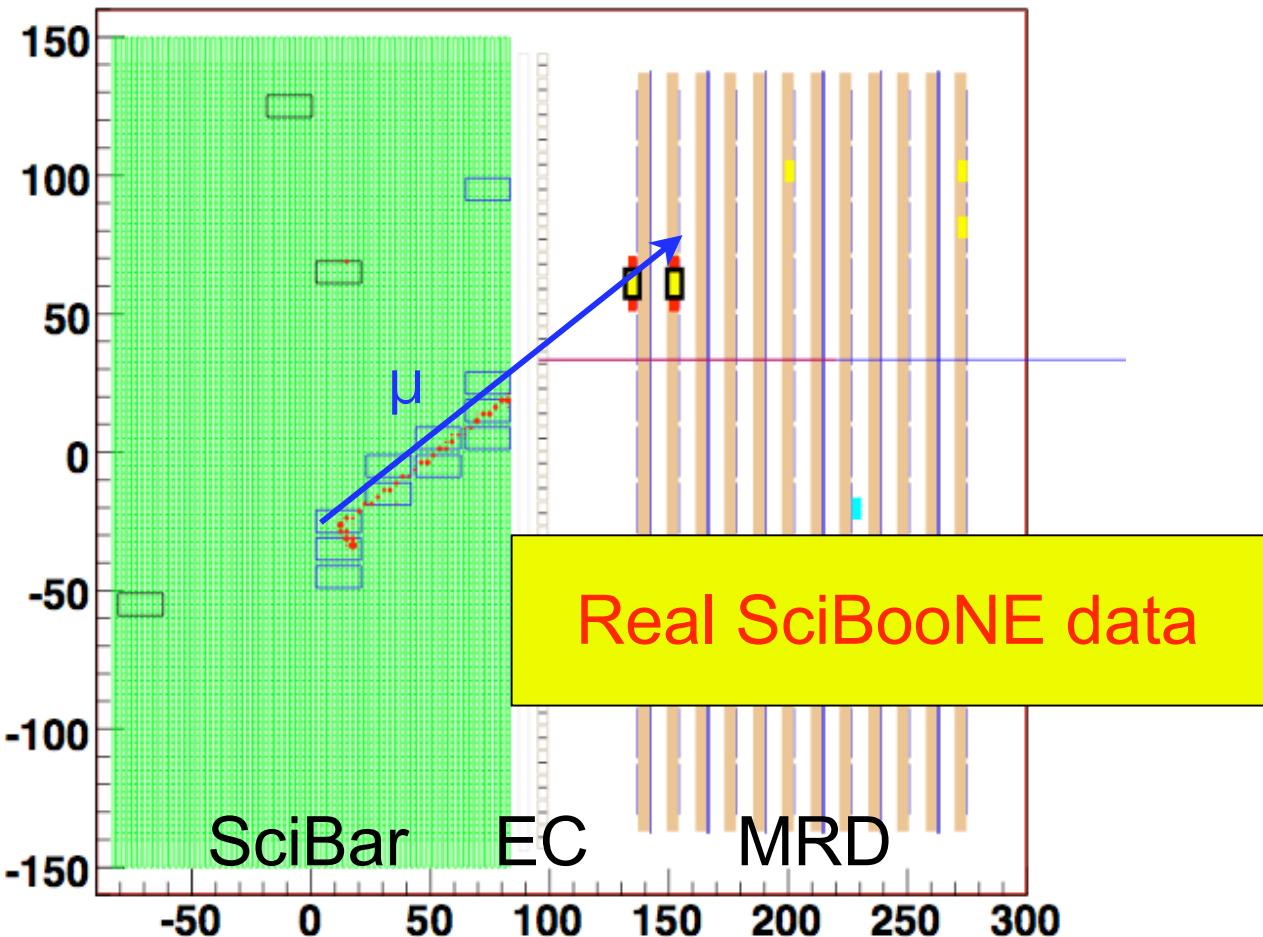
**EC:** EM calorimeter  
**Lead+scinti.**  $11X_0$   
Electron, gamma ID

**Muon Range Detector (MRD)**  
12 x [2" thick Fe plates] + scinti.  
Measure  $\mu$  momentum with range

- Momentum up to 1.2GeV/c
- Hit finding efficiency: ~99%

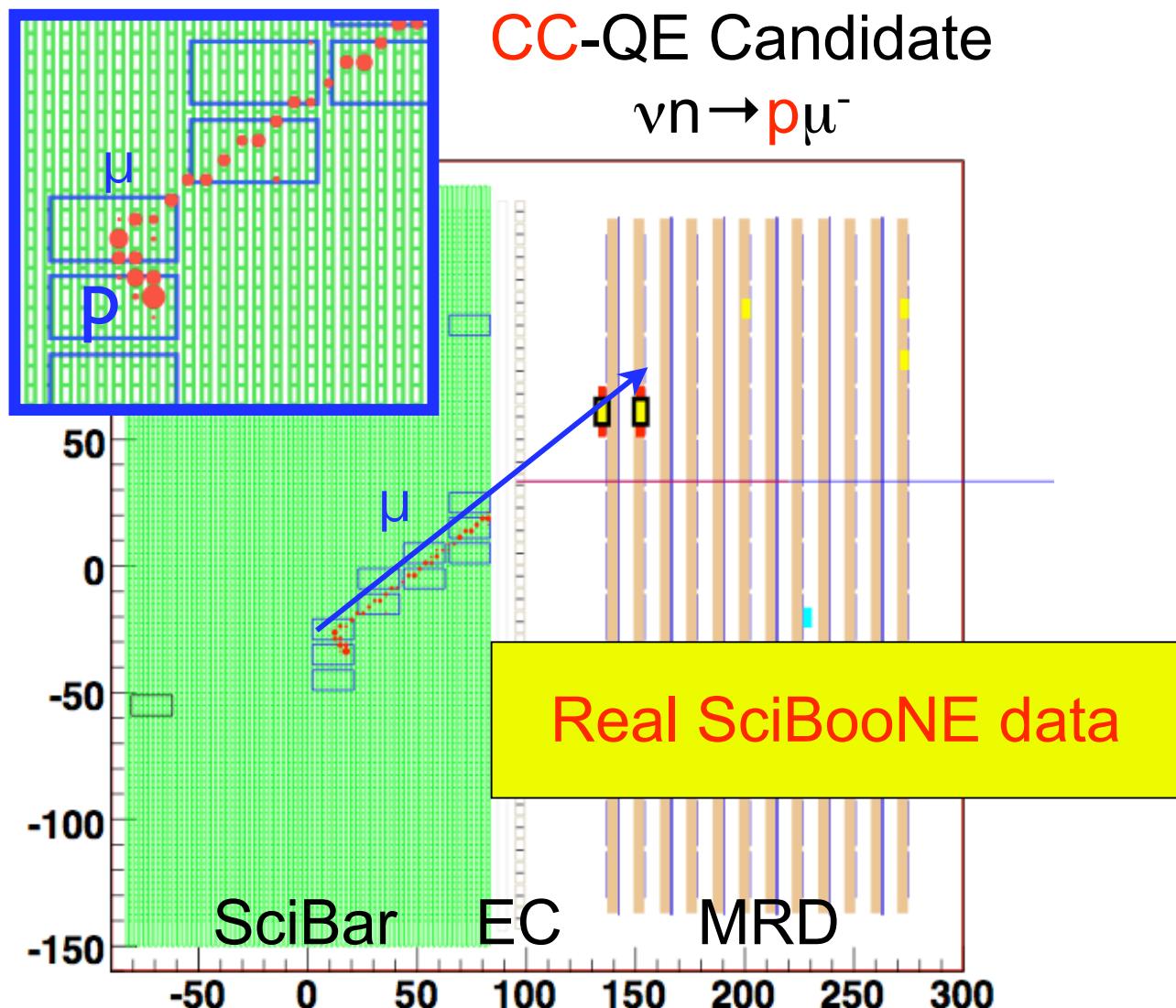
# $\nu$ event candidates

CC-QE Candidate  
 $\nu n \rightarrow p \mu^-$



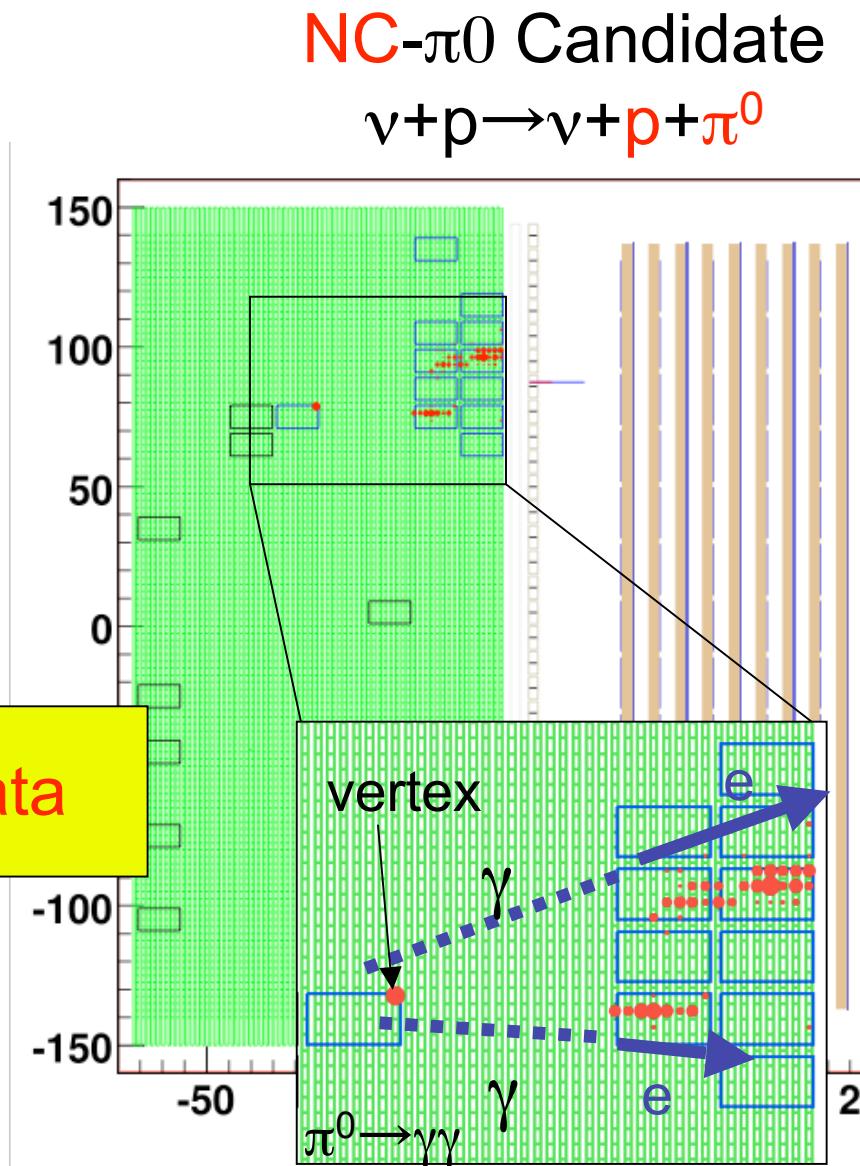
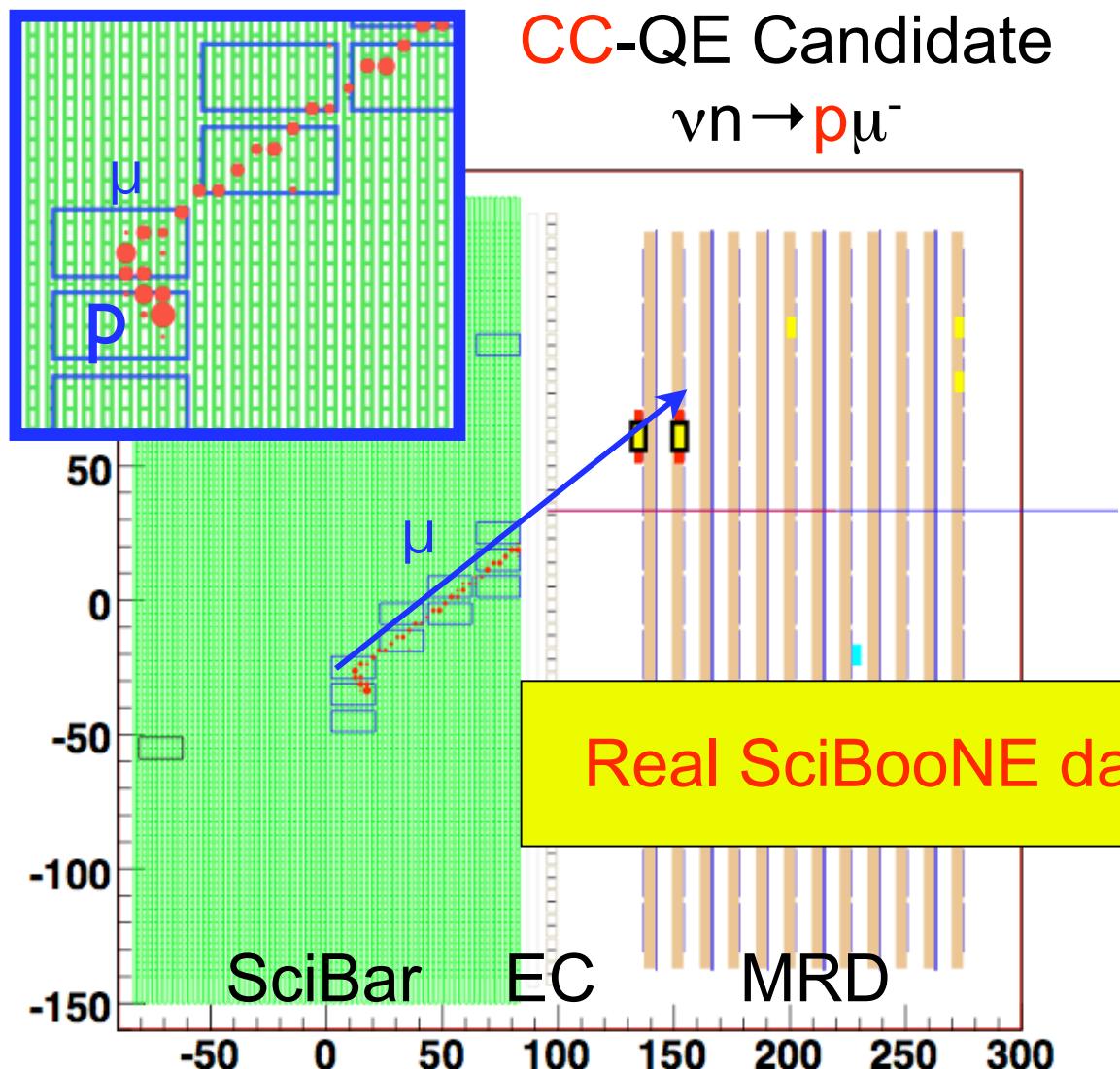
- : SciBar hit, area  $\propto$  energy deposit
- ◻: TDC hit (1 box = 32ch OR-ed)

# $\nu$ event candidates



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# $\nu$ event candidates

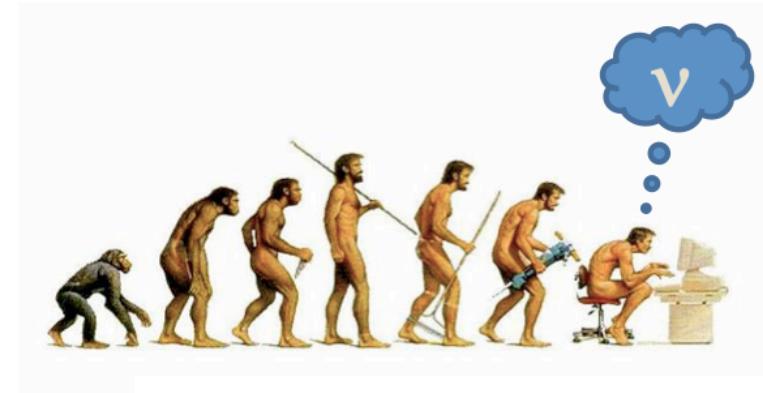


- : SciBar hit, area  $\propto$  energy deposit
- ◻: TDC hit (1 box = 32ch OR-ed)

# Timeline & Current status

# SciBooNE Timeline

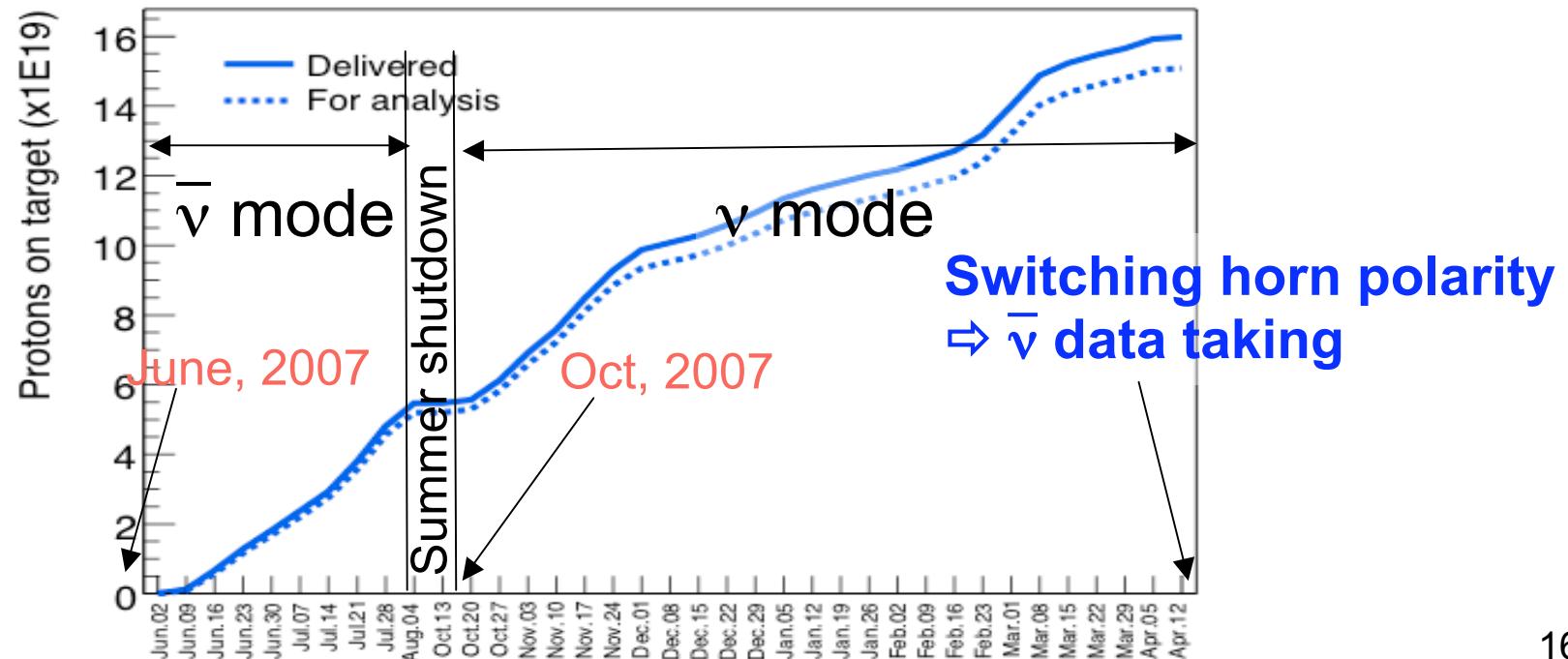
- 2005, Summer - Collaboration formed
- 2005, Dec - Proposal
- 2006, Jul - Detectors move to FNAL
- 2006, Sep - Groundbreaking
- 2006, Nov - EC Assembly
- 2007, Feb - SciBar Assembly
- 2007, Mar - MRD Assembly
- 2007, Mar - Cosmic Ray Data
- 2007, Apr - Detector Installation
- 2007, May - Commissioning
- 2007, Jun - Anti-Neutrino Data Run
- 2007, Oct - Neutrino Data Run
- 2008, Apr - Complete Neutrino mode data taking
- 2008, Apr - Switch horn polarity ( $\nu \rightarrow \bar{\nu}$ )



Two years from  
formation to first data!

# Data taking status

- Projected Protons On Target (POT): 2E20
  - ~1 year run
- Total collected POT so far: 1. 51E20
  - $\nu$ : **~1.0E20** (goal: 1E20) ← **Completed!!**
  - $\bar{\nu}$ : **~5.2E19** (goal: 1E20)
- Averaged detector live time fraction: **94%**



# Physics Topics

Several analyses are in progress

- Charged Current
  - CC inclusive: Y. Nakajima (Japan)
  - CC-QE: J. Alcaraz (Spain), J. Walding (UK)
  - CC- $\pi^+$ : K. Hiraide (Japan)
  - CC- $\pi^0$ : J. Catala (Spain)
- Neutral Current
  - NC- $\pi^0$ : Y. Kurimoto (Japan)
  - NC-elastic: H. Takei (Japan)
- $\nu_\mu$  disappearance: K. Mahn (US)

Listed here is  
PhD students  
only

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In the following talks;

- Neutrino data (no  $\bar{\nu}$  data)
- 7.7E19 POT is used
- Preliminary results (no systematic uncertainties)

# Summary → Introduction

- SciBooNE Experiment is  $\nu$  experiment at FNAL
  - Precision measurement of  $\nu$  &  $\bar{\nu}$  cross sections at ~1GeV
  - Use SciBar and Booster Neutrino Beamline
  - Data taking have been started June, 2007
    - $\nu$ : ~1.0E20 POT (goal: 1E20) ←Completed last week!!
    - $\bar{\nu}$ : ~5.2E19 POT (goal: 1E20)
- SciBooNE has excellent capability to study several neutrino interactions.
- Several physics analyses are in progress.
  - See the following talks!